EXHIBIT AE

ELEVENTH EDITION

PHOTOGRAPHY

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PEARSON

Brief contents

RINKO KAWAUCHI
Untitled,
from the series *Illuminance*, 2007

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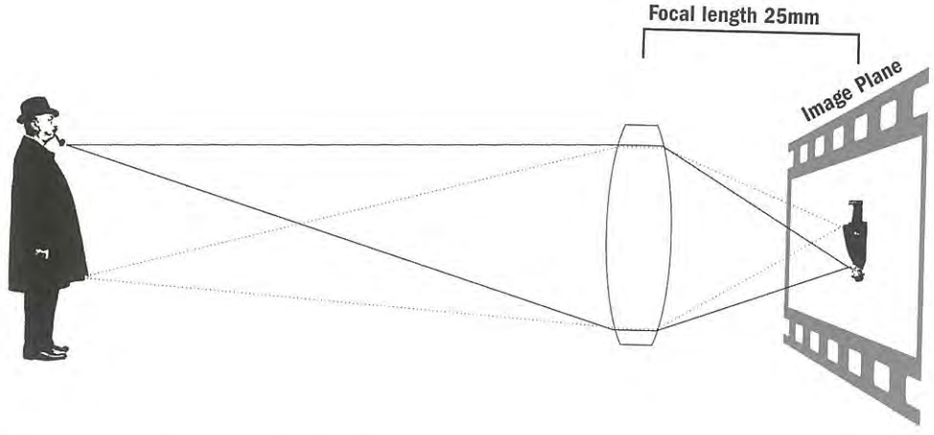
Lens Focal Length

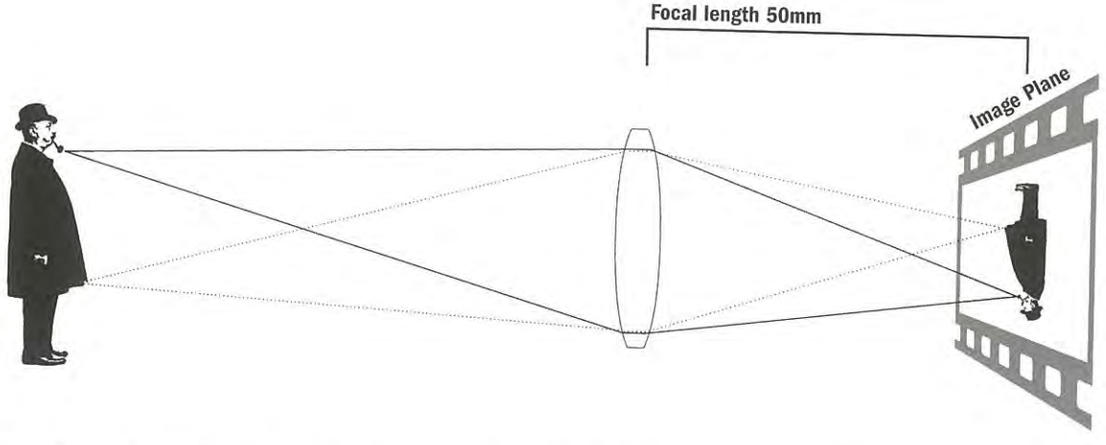
The most important way lenses differ is in their focal length. Because the camera you are most likely to choose can be used with interchangeable lenses, you can also choose which lens or lenses to buy or use. A lens is often described in terms of its focal length (a 50mm lens, a 12-inch lens) or its relative focal length (normal, long, or short). Technically, focal length is the distance between the lens' rear nodal point and the focal (image) plane when the lens is focused at infinity. Theoretically, infinity is a distance immeasurably far away, beyond the edge of the universe. In photographic terms, infinity is a distance from which light enters the lens in parallel rays. Lens designers call the image point where those rays come together, behind the lens, the focal point.

Focal length controls magnification, the size of the image formed by the lens. The longer the lens, the greater the size of objects in the image (see diagrams, right) that is projected on the film or sensor.

Focal length also controls angle of view, the amount of the scene shown on a given size of sensor or film (see photographs, opposite). A long-focal-length lens forms a larger image of an object than a short lens. As a result, on a given size of sensor or film, the longer lens includes less of the scene in which the object appears. If you make a circle with your thumb and forefinger and hold it close to your eye, you will see most of the scene in front of you—the equivalent of a short lens. If you move your hand farther from your eye—the equivalent of a longer lens—the circle will be filled by a smaller part of the scene. You will have decreased the angle of view seen through your fingers. In the same way, the longer the focal length, the smaller, or narrower, the angle of view seen by the lens.



A lens of short focal length bends light sharply. *The rays of light focus close behind the lens and form a small image of the subject.*



A lens of longer focal length bends light rays less than a short lens does. *The longer the focal length, the less the rays are bent, the farther behind the lens the image is focused, and the more the image is magnified. The size of the image increases in proportion to the focal length. If the subject remains at the same distance from the lens, the image formed by a 50mm lens will be twice as big as that from a 25mm lens.*

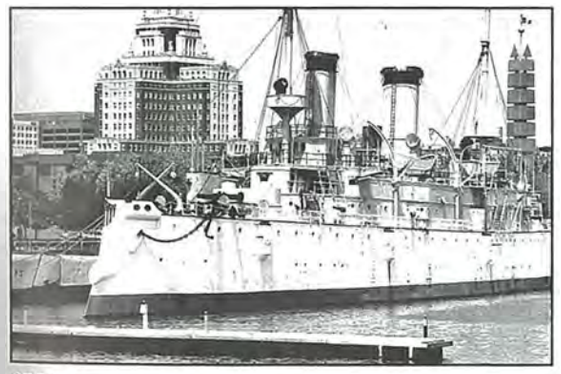
Watch the video Seeing With Lenses on myartslab.com

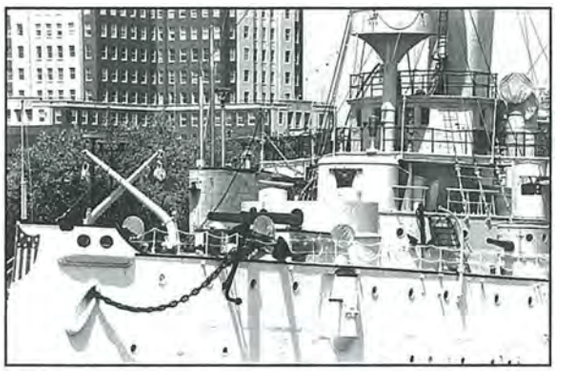

17mm

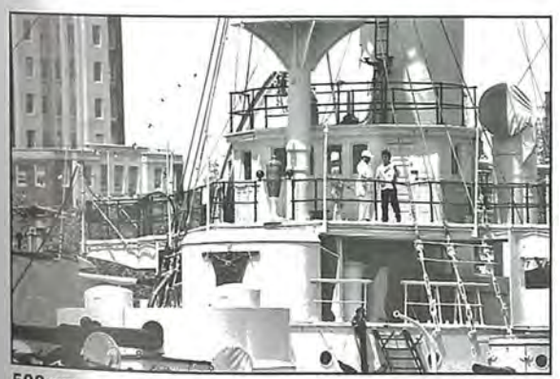

28mm


50mm


85mm

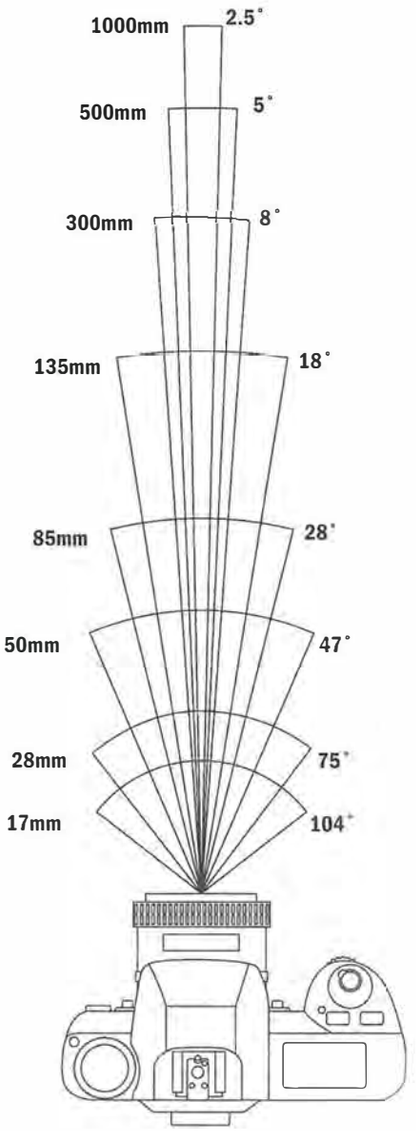

135mm


300mm


500mm


1000mm

The effect of increasing focal length while keeping the same lens-to-subject distance is an increase in magnification and a decrease in angle of view. *Because the photographer did not change position, the sizes of objects within the scene remained the same in relation to each other. The diagram below shows the angle of view of some of the lens focal lengths that can be used with a 35mm or "full-frame" digital camera. The lens focal length for other digital cameras is often stated as a "35mm equivalent."*



Lens Focal Length continued

Normal Focal Length

A normal-focal-length lens, also called a standard-focal-length lens, approximates the impression human vision gives. One of the greatest of modern photographers, Henri Cartier-Bresson, who described the camera as "an extension of my eye," often used a normal lens. His picture opposite includes as much of the scene as you would probably be paying attention to if you were there, the angle of view seems natural, and the relative size of near and far objects seems normal.

A lens that is a normal focal length for one camera can be a long or short focal length for another camera. Sensor or film size determines what will be a normal focal length. The larger the size, the longer the focal length of a normal lens for that format; it corresponds roughly to the measurement of a diagonal line across the sensor surface or film frame (see below).

A camera using 35mm film takes a 50mm lens as a normal focal length (50mm is about two inches). It is also normal for a 24 x 36mm (full-frame) digital sensor, the same size as a 35mm film frame. For a camera using 4 x 5-inch film, a 150mm lens is normal. The sensors in most digital cameras are smaller than a 35mm frame, so their normal lenses are shorter than 50mm. Usage varies somewhat: for example, lenses from about 40mm to 58mm can be referred to as normal focal lengths for a 35mm camera.

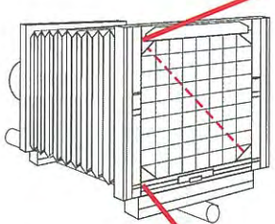
A lens of normal focal length has certain advantages over lenses of longer or shorter focal length. Most normal lenses are faster; that is, they open to a wider maximum aperture, so can be used with faster shutter speeds or in dimmer light than lenses that do not open as wide. They often are less expensive, more compact, and lighter in weight.

Choice of focal length is a matter of personal preference. Some photographers habitually use a shorter focal length because they want a wide angle of view most of the time; others prefer a longer focal length that narrows the angle of view to the central objects in a scene. If you aren't sure, start with a normal-focal-length lens.

*A lens of **a given focal length** may be considered normal, short, or long, depending on the size of the film you are using or the sensor in your digital camera. If the focal length of a lens is about the same as the diagonal measurement of the light-sensitive surface (broken line), the lens is considered "normal." It collects light rays from an angle of view of about 50°.*

The photograph on the right was taken with a 4 x 5 view camera using a 150mm lens. The diagonal measurement of 4 x 5-inch film is about 150mm, so a 150mm lens is a normal focal length for that size film.

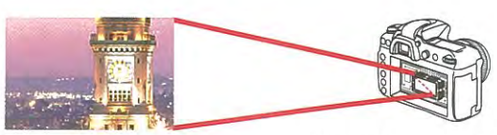
But 150mm is much longer than the diagonal of a 35mm film frame or a sensor the same size, called full frame. A 150mm lens is a long-focal-length lens for these cameras and—because most digital sensors are smaller than a 35mm frame—it is very long for most DSLRs (see bottom photos, right).



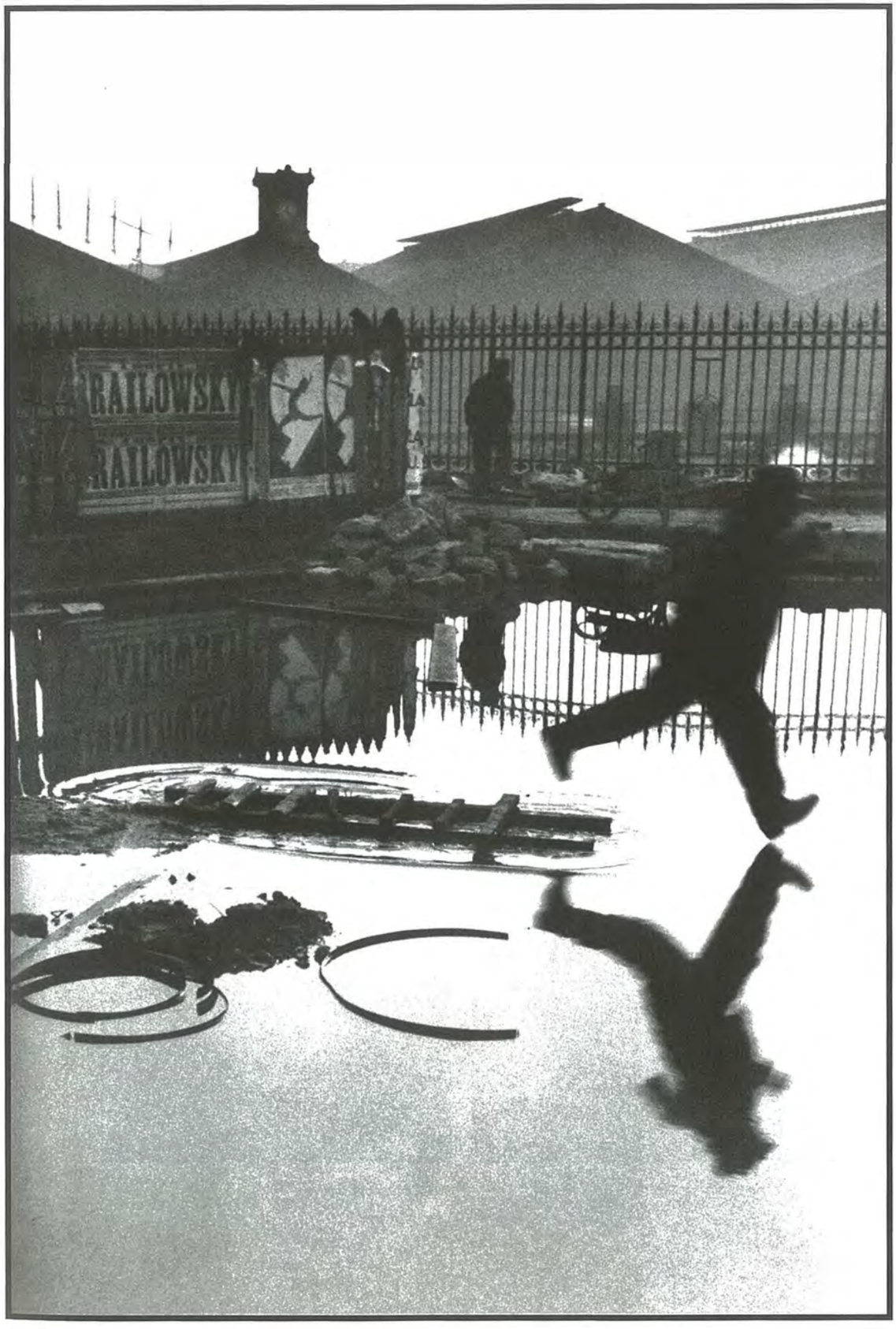
View of 150mm lens on a 4 x 5-inch view camera

PETER VANDERWARKER Custom House Tower and Central Artery Before the Big Dig, Boston, 1989

View of 150mm lens on a 35mm camera or full-frame DSLR



View of 150mm lens on a DSLR camera with an APS-C sensor (about 16 x 24mm)



HENRI CARTIER-BRESSON
Place de l'Europe, Paris, 1932

Using a normal-focal-length lens is a way for the photographer to let the subject speak. *Wide and long lenses make a stronger statement about the technical decisions a photographer must make, such as about perspective or depth of field.*

Although Cartier-Bresson resisted discussing technique, it is known that he frequently used a normal (50mm) lens on his 35mm Leica camera. In this case, the size relationships in the frame—clues that give us our sense of perspective—are not unusual. We are drawn to what the photographer wants us to notice, the poetry of an instant snatched from the fabric of time itself. Cartier-Bresson called this a "decisive moment."

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Lens Focal Length continued

Long Focal Length

A long-focal-length lens provides greater image magnification and a narrower angle of view than a normal lens. For a 35mm camera (or a DSLR camera that uses a full-frame sensor) a popular and useful long focal length is 105mm. For a camera using 120 film for 6 x 7cm negatives, a popular comparable focal length is 150mm; for a 4 x 5 view camera, it is about 300mm. Most DSLR and compact digital cameras have sensors smaller than a 35mm frame; there is a multiplier factor you can use to compare angles of view to lenses for 35mm use. A digital camera with a 22.5 x 15mm sensor has a multiplier of 1.6; any lens on that camera will have the same angle of view as a lens with a 1.6 times longer focal length on a 35mm film camera. For example, a 65mm lens used with a 22.5 x 15mm sensor will be comparable to a 105mm lens used on a 35mm film camera.

Long lenses are excellent when you cannot or do not want to get close to the subject. In the photograph opposite, the photographer seems to be in the middle of the action even though he is not. Long lenses make it possible to photograph birds and animals from enough distance that they are not disturbed. Medium-long lenses are excellent for portraiture; most people become self-conscious when a camera is too close to them so their expressions are often artificial. A long lens used at a moderate distance also avoids the kind of distortion that occurs when shorter lenses used close to a subject exaggerate the size of whatever is nearest the camera—in a portrait, usually the nose (see below).

There are subtle qualities that can be exploited when you use a long lens. Because a long lens has less depth of field, objects in the foreground or background can be photographed out of focus so that the sharply focused subject stands out clearly. (See page 13, top.) Also, a long lens can be used to achieve an unusual perspective in which objects seem to be closer together than they really are (see opposite page).

Long lenses have some disadvantages, and the longer the lens the more noticeable the disadvantages become. Compared to lenses of normal focal length, they usually are heavier, bulkier, and more expensive, especially telephotos with wide apertures. Because they have relatively shallow depth of field, they must be focused accurately. They are difficult to use for hand-held shots because they magnify lens movements as well as subject size. The shutter speed for a medium-long lens, such as an unstabilized 105mm lens on a 35mm camera, should be at least 1/125 second if the camera is hand held. For an unstabilized 200mm lens, you will need at least 1/250 sec. Otherwise, camera movement may cause blurring. A tripod or other support is your best protection against blurry photos caused by camera movement.

Photographers commonly call any long lens a telephoto, or tele, although not all long lenses are actually of telephoto design. A true telephoto has an effective focal length that is greater than the actual distance from lens to focal plane. This design makes the lens shorter and easier to handle. A tele-extender or teleconverter contains an optical element that increases the effective focal length of any lens. It attaches between the lens and the camera body and magnifies the image from the lens onto the film. With these devices, the effective length of the lens increases, but less light reaches the film. A converter that doubles the lens focal length, for example, loses two f-stops of light.

Long lenses often produce better portraits. *A moderately long lens such as an 85mm or 105mm lens (35mm equivalent) used at least 6 ft from the subject (near right) makes a better portrait than a shorter lens used close to the subject (far right). Compare the size and shape of nose and chin in the two pictures of the same subject. Photographing a person at too close a lens-to-subject distance makes features nearest the camera appear too large and gives an unnatural-looking dimension to the head.*

Long lens, moderate distance

Short lens, up close

ED JONES Fisherman's Dragon Boat Races, Hong Kong, 2010

Athletes at sporting events, like these oarsmen, can be at a considerable distance. *Photographers often rely on long lenses—like the 500mm telephoto used here—to come in tight on the action. Jones set his lens to a medium aperture so he could use a high shutter speed and still get the side-by-side boats in focus.*

The sense that space in the picture is being compressed comes from the long distance between photographer and subject, not the lens. *See page 61 for more.*

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Lens Focal Length continued

Short Focal Length

A short-focal-length lens increases the angle of view and shows more of a scene than a normal lens used from the same position. A short lens (commonly called a wide-angle lens) is useful when you are physically prevented (as by the walls of a room) from moving back as much as would be necessary with a normal lens.

For a full-frame digital or 35mm camera, a commonly used short focal length is 28mm. A comparable lens for a 6 x 7cm film camera is 55mm. For a 4 x 5 view camera, it is 90mm.

Wide-angle lenses have considerable depth of field. A 24mm lens focused on an object 7 feet away and stopped down to f/8 will show everything from 4 feet to infinity in sharp focus. Photographers who work in fast-moving situations often use a moderately wide lens, such as a 35mm lens on a full-frame digital or 35mm film camera, as their normal lens. They don't have to pause to refocus for every shot because with this type of lens so much of a scene is sharp. At the same time it does not display too much distortion.

Pictures taken with a wide-angle lens can show both real and apparent distortions. Genuine aberrations of the lens itself such as curvilinear distortion are inherent in extremely curved or wide elements made of thick pieces of glass, which are often used in wide-angle lenses. While most aberrations can be corrected in a lens of a moderate angle of view and speed, the wider or faster the lens, the more difficult and/or expensive that correction becomes. Some curvilinear distortion (straight lines near the edges of the frame becoming curved) can be corrected with software, but the results are generally better if no distortion is introduced by the lens.

SLR cameras need a special kind of wide lens called a retrofocus, to leave room behind the lens for the reflex mirror to move. It is more difficult to correct aberrations in this kind of lens; wide-angle lenses for cameras without mirrors—rangefinders and view cameras—often perform better.

A wide-angle lens can also show an apparent distortion of perspective, but this is actually caused by the position of the photographer, not by the lens. An object that is close to a lens (or your eye) appears larger than an object of the same size that is farther away. Because a wide-angle lens is often used very close to an object, it is easy to exaggerate this size relationship (below and right). The cure is to learn to see what the camera sees and either minimize the distortion, or use it intentionally (page 61, right).

KARL BADEN
Amelia, 1995

A wide lens lets you work in close quarters, like this child's bedroom. *The unusual perspective, caused by a very short distance between lens and feet, creates a vision that is both amusing and a bit disorienting.*

FRANS LANTING
Tourists Explore Beach from which Ernest Shackleton Left for South Georgia, Elephant Island, Antarctica, 1988

With an ultra-wide-angle lens on his 35mm camera, *Lanting merged the 1916 launch of men hoping to save Ernest Shackleton's disastrous Antarctica expedition with that of visitors from a cruise ship who had come to the same beach 72 years later. This black-and-white image by Frank Hurley is one of the few that survived his expedition. Lanting located the Hurley negatives, had prints made, and brought them to Antarctica for a story about Shackleton.*

The wide-angle lens held close to Hurley's photograph increases its apparent size and makes the people in it look almost as large as those lined up at the boat in the background.

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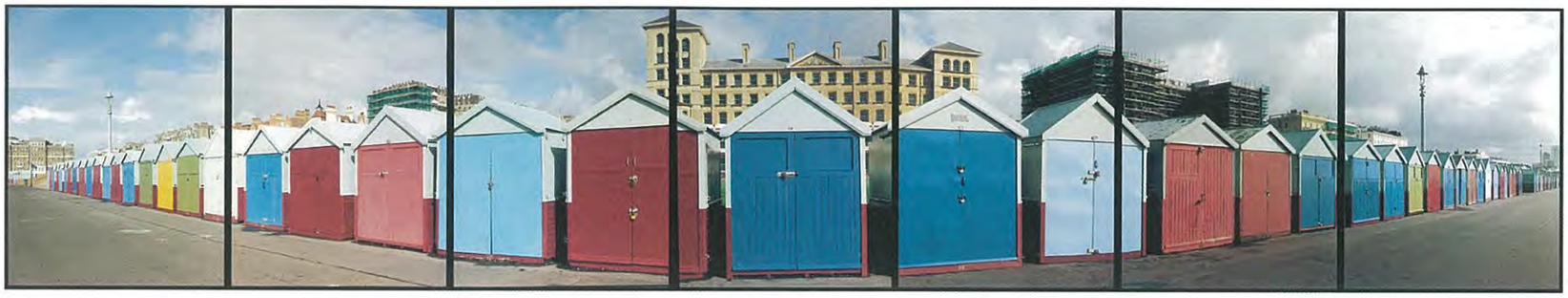
Color Balance

Color Changes throughout the Day



Colors in your photographs will vary depending on the time of day that you made them. Photographing very early or late in the day can produce strikingly beautiful pictures simply because the light is not its usual "white" color. As you become aware of color changes, you will be better able to predict the effect that the time of day will have on your pictures.

In the earliest hours of the day, before sunrise, the world is essentially black and white. The light has a cool, shadowless quality. Colors are muted. They grow in intensity slowly, gradually differentiating themselves. But right up to the moment of sunrise, they remain pearly and flat.

As soon as the sun rises, the light warms up. Because of the great amount of atmosphere that the low-lying sun must penetrate, the light that gets through is much warmer in color than it will be later in the day—that is, more on the red or orange side because the colder blue hues are filtered out by the atmosphere. Shadows, by contrast, may look blue because the gold sunlight doesn't reach them; they are only illuminated by blue from the sky.

The higher the sun climbs in the sky, the greater the contrast between colors. At noon, particularly in the summer, this contrast is at its peak. Most digital cameras and daylight color films are likely to render midday colors reasonably accurately, even though light from straight overhead rarely flatters anything you'd like to photograph. See the photograph on the opposite page for an exception.

As the sun goes down, the light begins to warm up again. This occurs so gradually that you must remember to look for it; otherwise the steady increase of red in the low light will do things to your photographs that you do not expect. Luckily, these things can be beautiful. If the evening is clear and the sun remains visible right down to the horizon, objects will begin to take on a golden glow that is typical of sunset light. Shadows lengthen, so surfaces become strongly textured.

After sunset there is a good deal of light left in the sky, often tinted by sunset colors. This light can be used, with longer exposures, almost to the point of darkness, and may produce pinkish or even greenish-violet effects that are delicate and lovely. Just as before sunrise, there are no shadows and the contrast between colors is low.

Finally, just before night, colors fade. With the tinted glow gone from the sky, colors disappear, and the world once again becomes black and white.

You can suppress or exaggerate these effects. Digital cameras let you adjust the way these subtle color shifts are recorded, and a colored filter over the lens will do the same with color film. See the page opposite.

At dusk, at dawn, and sometimes indoors, the light may be so dim that exposure times become very long, even with the lens aperture wide open. Very long exposures with film produce exposure and color problems because of reciprocity failure (see page 77). Very long exposures with a digital camera increase noise (see page 85).

ROBERT RICHFIELD Brighton/Hove, East Sussex, England, 1993

Midmorning and midafternoon are the best times to let the colors of the subject dominate. *Richfield took seven photographs leaving his tripod in the same location while rotating his large-format camera for each exposure.*

MANAMANA Arches National Park, Utah

Late in the day, *shadows are very long and colors are warm and golden. As the sun gets lower in the sky, the color of light moves to the reddish end of the spectrum, giving a warm tone to everything it illuminates.*

PETER TURNER Ibiza Woman, 1961

At twilight, at dawn, or under a cloudy sky, *colors are cool and blue.*

JOHN UPTON
Torii and Swimmer,
Lake Biwa, Japan, 2005

***Midday sunlight** is bright, with objects having the colors that record accurately with a digital camera set for a daylight white balance or on daylight film.*

"White" light sources are not all the same; their color is measured on a scale of temperature in degrees Kelvin (K). With film, the color temperature of a light source is called color balance, with digital it is called white balance. Accurate color in your photographs comes from a close match between the color of the light on your subject and the color balance of your film or the white balance you have set (or your camera has chosen) for your digital camera. Without that match, all the colors in a photograph will be shifted up or down the spectrum, becoming too cool (blue) or too warm (red).

A digital camera allows this color balance (called white balance) to be manually adjusted or determined automatically by the camera. Nothing changes about the way the sensor records light; the white balance setting only controls how that information is displayed as a preview on the camera's monitor or later when the picture file has been transferred to a computer. White balance can be further adjusted after the exposure has been made. Most digital cameras set a white balance of 5200K for daylight.

Color films produce the most natural-looking results when you use one that matches the color temperature of the source. Daylight film, with a balance of 5500K, is accurate when exposed in the relatively bluish light of daylight (below, far left) or electronic flash. Tungsten-balanced films (3200K) should be used when photographing in the relatively reddish light of incandescent bulbs. Filters are available to adapt either film to fluorescent light or to change the color balance in other ways (MyArtsLab.com Appendix C-3 and -4). A very light blue filter, for example, can reverse the warming effect of late-afternoon sun.

***Setting a digital camera's white balance to daylight or using daylight color film is correct for the relatively bluish color balance of midday light** (5500K color temperature), as in the left photo. In open shade (second photo) the results are more blue, because the light from a blue sky has a higher color temperature than direct sunlight. If you use a daylight white balance or daylight color film in the warmer light of a tungsten bulb (third photo, about 2800K), your picture may look more reddish than you expect. The fourth photo was taken under fluorescent light, which tends to have proportionately more green than daylight. In each, a piece of white cardboard was held behind the man, and he is wearing the same gray shirt.*

5500K DAYLIGHT FILM ➤

3200K TUNGSTEN FILM ➤